Measurement Science and Standards in Forensic Handwriting Analysis Conference
Facilitated Discussion Summary
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Introduction

On June 4 – 5, 2013, the National Institute of Standards and Technology (NIST) hosted the Measurement Science and Standards in Forensic Handwriting Analysis Conference in Gaithersburg, Maryland. NIST planned and organized this event in collaboration with the American Academy of Forensic Sciences – Questioned Document Section, American Board of Forensic Document Examiners, American

> *NIST has been involved in forensic science research and collaboration for decades, working to bolster the scientific foundation upholding forensic processes and conclusions.*

Society of Questioned Document Examiners, Federal Bureau of Investigation Laboratory, National Institute of Justice (NIJ), and Scientific Working Group for Forensic Document Examination (SWGDOC). Attendees, both in person and via a live webcast, included representatives from the collaborating institutions as well as universities, federal agencies, state and local crime laboratories, international forensic laboratories, and the private sector.

The conference consisted of nearly 2 days of presentations from experts in the field of forensic handwriting analysis. These presentations covered the history and current state of the practice as well as the latest advances in quantitative analysis methods and statistical models that could enhance the discipline. To conclude the event, moderators led a facilitated discussion on the future of forensic handwriting analysis, specifically focusing on the following questions:

- What does the future state of handwriting analysis look like?
- What are the barriers to implementing the future state?
- What does a roadmap to achieve the future state look like?

This report summarizes the concluding discussion, including conversations in the room and comments submitted online. Although not every participant agreed with every comment, this summary gives a general sense of the discussion, and the captured comments used to build this document were unattributed. The report concludes with general recommendations for implementing the future state of forensic handwriting analysis, and an appendix lists some future research needs.

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What does the future state of handwriting analysis look like?

The future state of the discipline will incorporate the use of more quantitative analysis tools during the handwriting examination process to assess and compare handwriting characteristics. Forensic document examiners (FDEs) will employ the use of statistical models to explain the significance of their conclusions based on the uniqueness of observed and measured handwriting characteristics. Researchers will publish more studies involving the use of quantitative methods for examinations in peer-reviewed journals, which will improve the understanding of these advancements and will validate examination methods.

There will be more peer review of casework and proficiency testing requirements in the discipline as all forensic disciplines move toward mandatory accreditation and certification. The appropriate construction and extrapolation of proficiency testing to the real working environment will provide useful data in determining error rates. The use of appropriately controlled peer review will be more commonplace, which will further reduce error rates. Some FDEs believe that peer review and proficiency testing will be required by the court system.

There will also be a more systematic way to convert research into best practices that examiners can incorporate into their standard operating procedures. Previously established standards will be updated or validated as new technology is used to test long-standing practices. The formal use of statistics

SWGDOC develops and publishes standards, guidelines, and sub-discipline-specific operating procedures for forensic document examination.

will help with determining uncertainty and the strength of similarities between compared writings. The opinion scale currently used by examiners will change as research in the discipline continues. As research demonstrates a better understanding of the frequency of characteristics in handwriting samples, FDEs will be able to formalize their conclusions in a uniform, quantifiable fashion.

It is important to note that automated comparison systems may be considered separate from statistical models, as automated systems can facilitate the matching of a known writer with questioned documents without necessarily generating statistics. This technology provides support during the

Automated systems can make an initial analysis and comparison of handwriting samples to assist the human FDE.

examination process and may provide new information for the human examiner to consider. FDEs can use statistics and automated systems to complement their current practices and to enhance the way they review cases, but neither can replace humans.

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In current standard practice, when an FDE determines the genuineness, simulation, or disguise of a handwriting sample, the FDE is often mentally calculating the frequencies of observations of certain strokes and specific features, studying the geometrical outlines and areas of letters, developing ratios between extenders and small letters, noting the variability of indicators, and more. Ironically, the FDE conclusions already involve approximate mental "statistical observations," but they do not include a metrical evaluation of the parameters. Discussion participants believe it is quite reasonable to start generating on paper the calculations that FDEs usually perform mentally without any actual measuring.

Some of the participants noted that in the future, courts will demand more statistical data with conclusions because of the prevalence of the use of DNA results in the court system. Reporting of results in the criminal justice system is changing toward understanding that there are degrees of confidence, and FDEs will have to deal with statistics to show this. However, participants believe that while statistics will help in practice and in explaining conclusions to attorneys and judges, this data will not be helpful to juries during court testimony. Many FDEs will instead present conclusions with images that present a clearer picture to the jury than statistical jargon would.

Society will continue to move away from formal education on handwriting and penmanship and will instead focus on using a keyboard to draft communications. This lack of formal education may result in individual handwriting styles becoming more unique and identifiable and may encourage the use of hand-printing when drafting written communication.

What are the barriers to implementing the future state?

Many FDEs and other forensic professionals believe that statistical information may, at best, be too complicated for a jury to fully understand or, at worst, be manipulated during cross-examination to show excessive doubt. Given that many FDEs lack statistical training, they may have a hard time explaining ratios and probability to a jury if required. FDEs may also have difficulty communicating with statisticians to get the information they need due to unclear terminology and disagreements among statisticians over which method can best answer the question.

The field of forensic handwriting analysis is aging, and current FDEs may struggle to accept new procedures and technologies. In some laboratories, the document examination caseload is sharply declining as FDEs retire and their positions are left unfilled, while DNA analysis units in the same laboratories continue to expand. In addition, crime scene evidence collectors sometimes deliver evidential documents to other units of the forensic laboratory, such as the latent print unit, without considering the value an FDE's analysis could offer. In

some cases, law enforcement has reduced criminal investigations involving forensic document evidence. Since forgeries of wills and contracts are now relegated to civil courts for investigation and resolution, citizens must pay out of pocket for private FDE analysis while federal, state, and local taxes are applied to fund DNA analysis and other disciplines in crime laboratories. This shift presents challenges for the future of forensic handwriting analysis.

Additional research is required to move the field forward, but studies are often expensive and require a high level of training and expertise to execute properly. FDEs have difficulty connecting with experienced researchers to discuss future research needs and ideas. Traditionally, FDEs have conducted most forensic handwriting research outside their normal casework without additional funding, often focusing on case-specific questions (but this trend has been changing recently). Without additional research funding, it will be difficult to validate existing processes, to develop new techniques, to create and improve automated analysis tools, or to collect data from handwriting samples. Until recently, practitioners performing research have published most of their papers on forensic handwriting analysis in professional association journals with targeted readership or presented them during discipline-specific conferences. In addition, although researchers usually appreciate thoughtful and appropriate criticisms of their work, this criticism can frustrate FDEs, who are sometimes asked to address it in court during cross-examination.

What does a roadmap to achieve the future state look like?

The future state of forensic handwriting analysis relies on increased research to validate existing methods and to provide FDEs with new methods and information that can help improve the discipline. To date, NIJ has been financially supportive of forensic handwriting analysis research, but support from other agencies would extend the research program further and would allow additional collaboration opportunities through interagency and public-private sector partnerships and meetings. Additional funding and collaboration would allow researchers to conduct studies that can be published in top-tier, peer-reviewed, general science journals, which could increase the visibility and validity of the science.

Through grants, NIJ provides funding to conduct physical and social science research on the criminal justice system and forensic methodologies.

FDEs and statisticians will need to collaborate more regularly to identify the statistical methods that will best help in casework and testimony and to test them with real-world data. In some larger laboratories, statisticians already form part of the forensic unit, which increases collaboration opportunities and encourages the formal use of statistics in casework. To further support this collaboration, FDEs will need to receive formal training in the use of

statistics. In addition, collaboration with other FDEs through peer-review of casework and proficiency testing could increase the validity of conclusions and could enhance testimony.

Because FDEs with no additional funding or training have traditionally conducted forensic handwriting analysis research, most studies have focused on case-specific questions instead of larger issues that could be applied to the discipline as a whole. In collaboration with academic statisticians and other researchers, FDEs should leverage graduate students who can write master's theses on specific forensic science problems while earning their degrees. This strategy contributes to the education and real-world experience of the student and frees the professor/researcher to focus on questions with a larger impact on forensic science. It may also help students develop an interest in forensic handwriting analysis, which could make it easier for laboratories to hire recent graduates with the proper qualifications, such as degrees in science, statistics, computer science, or chemistry. Major associations representing FDEs should consider a campaign to attract the next generation. For the discipline to thrive and progress, new scientists must be recruited to carry on scientific advancements and to employ the resulting techniques in the crime laboratory. In addition, reaching into the

> *Graduate students, especially in the fields of science, statistics, computer science, or chemistry, could conduct studies on forensic handwriting analysis.*

academic environment would allow for collaboration with other fields of study that may have similar questions or existing statistical models that could enhance forensic handwriting analysis research. For example, the field of psychology may help FDEs understand how jurors interpret information presented during testimony, which could lead to improvements in how FDEs present forensic conclusions in court through visual aids, degrees of confidence language, or statistical probabilities.

Advances in technology and validation of forensic handwriting methods can help increase the forensic handwriting analysis caseload, which is declining in some laboratories. More training and education for law enforcement officials on FDE capabilities could help crime scene investigators identify more documents for FDEs to analyze as potential evidence. As existing technological aids are tested and validated, FDEs should incorporate them into casework with a full understanding of the value they offer and the processes involved. Although modern communication is more often typed rather than handwritten, additional technological advancements could eventually allow FDEs to analyze high-resolution electronic signatures and to conduct linguistic analysis on documents. FDEs must also continue to develop and review their processes and standards to support existing and forthcoming technology, and crime laboratories must provide access to and training on these new tools. Researchers, technology developers, and FDEs will need access to datasets to conduct reliability and reproducibility studies on FDE performance and newly developed quantitative measurement systems.

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Recommendations

1. FDEs should receive basic statistical training relevant to forensic handwriting analysis to help formalize the use of statistics in casework and to communicate statistical findings to the court.

2. Through SWGDOC and the American Statistical Association's ad hoc committee on forensic science, FDEs should collaborate with statisticians to develop better statistical models to address handwriting analysis challenges.

3. NIJ should continue its enthusiastic support of forensic handwriting analysis research, and other agencies should contribute to this support.

4. FDEs should collaborate with academic institutions and should leverage graduate students to conduct studies on case-specific questions.

5. Researchers should strive to publish forensic handwriting analysis studies in top-tier, peer-reviewed journals to invite the level of scrutiny and acceptance experienced by other scientific fields.

6. Through SWGDOC, FDEs should develop an expanded and standardized list of conclusions with degrees of confidence based on scientific research.

7. FDEs and researchers should consider establishing an open-source data set with anonymous handwriting samples similar to real-world casework to use in testing and validating technological tools and statistical models.

8. NIST should consider serving as a repository for handwriting datasets and should make this material available to FDEs and researchers to test new technological developments.

9. Through SWGDOC, FDEs should revise and develop standards that apply to the latest technological advances.

10. Professional associations that represent FDEs should consider launching campaigns to attract younger scientists to the discipline.

Appendix A: Research Needs in Forensic Handwriting Analysis

The summary list below includes areas for future research as identified by conference presenters. This should not be viewed as a comprehensive list of forensic handwriting analysis research needs.

- Stages of expertise development, including the influence of practiced skill compared with inherent talent and the effect of education and training

- The comparison process, especially related to FDE attention, perception, cognitive bias, and decision-making capabilities

- Forensic conclusions, including probability- and frequency-based judgments, opinion scales, and degree of confidence language

- Dynamic human movements that lead to different handwriting behaviors, especially compared to static traces

- Individual error rates, especially comparing untrained lay-person conclusions to FDE conclusions

- Handwriting characteristics within homogenous populations

- The effect of FDE collaboration and peer review of casework

- FDE ability to detect and compare simulated (forged) and disguised handwriting

- Ability of FDEs to analyze foreign handwriting, especially characters not used in the FDE's native language